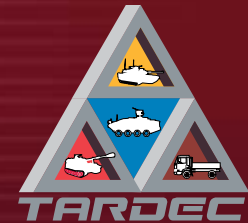


# FIRE PROTECTION FOR MILITARY GROUND VEHICLES

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## MILESTONES



Dist A.

<b>WW I</b>	Introduction of tanks and flamethrowers
<b>WW II</b>	M4 Sherman tank
<b>1949</b>	Army/Purdue study identifies halon 1301
<b>1960s – 70s</b>	Conversion from gasoline to diesel fuel
<b>1980</b>	Halon 1301 automatic fire extinguishing systems fielded
<b>Early 1990s</b>	JP-8 selected as Single Fuel on the Battlefield
<b>1995</b>	Production of halons ended due to environmental impact



# CREW PROTECTION



Parameter	Requirement <sup>(1)</sup>
Fire Suppression	Extinguish all flames without reflash
Skin Burns	Less than second degree burns or $<2400^{\circ}\text{F}\cdot\text{sec}$ over 10 seconds heat flux $< 3.9 \text{ cal/cm}^2$
Overpressure	Less than 11.6 psi
Agent Concentration	Not to exceed LOAEL <sup>(2)</sup>
Acid Gases (HF + HBr + $2\text{COF}_2$ )	Delayed Incapacitation 746 - 2237 ppm-min (5 min) Immediate Incapacitation 1491- 4473 ppm-min (5 min)
Oxygen Levels	Not below 16% for 5 sec average
Discharge Noise	Below single hearing protection limit (165 dB)
Discharge Forces	Not to exceed 8 G over 30 ms

1 – Walter Reed Army Institute of Research “Medical Evaluation of Non Fragment Injury Effects in Armored Vehicle Live Fire Tests” Sep 1989

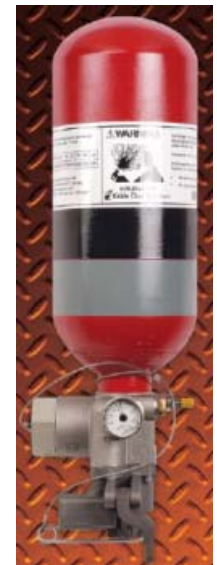
2 - Lowest Observed Adverse Effects Level

- Halon 1301 replaced by FM-200BC in new applications starting in 2001
- High GWPs may restrict use of HFCs, including FM-200

Dist A.



Detection  $< 2 \text{ msec}$



Opening  $< 10 \text{ msec}$   
Discharge  $< 165 \text{ msec}$



# EXTERNAL FIRE THREATS



Dist A.

- A number of vehicles have been lost in theater due to fires caused by ballistic attacks as well as mechanical failures.
- Deep-seated external fires can result in total loss of vehicles and cargo and potential casualties
- Internal extinguishing system and portable extinguishers not intended to address external fires
- Onboard fuel is particularly susceptible to attack
- Tires/track and external stowage represent secondary fire vulnerabilities







FIRE PROTECTION FOR MILITARY GROUND VEHICLES

# FUEL TANK PROTECTION

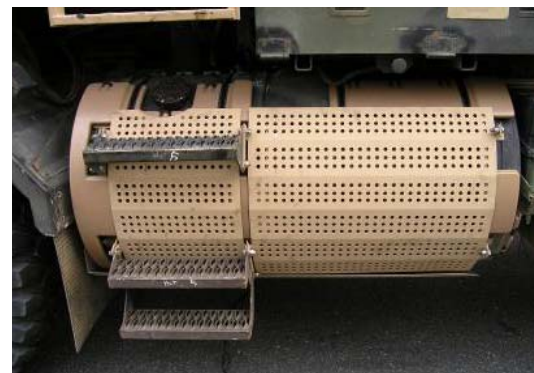


Dist A.



Baseline

Panel





FIRE PROTECTION FOR MILITARY GROUND VEHICLES

# TIRE FIRE PROTECTION

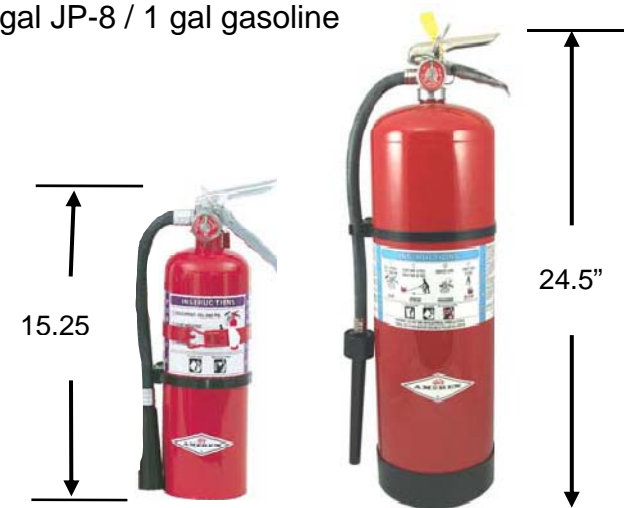


Dist A.

- Current vehicle fire extinguishers were selected primarily to address POL fires
  - Limited effectiveness against *deep-seated* tire fires
- Water-based agents in 2.5 gal portable have successfully extinguished tire fires
- Fixed systems w/ heat detection have successfully extinguished test fires
  - dry chemical
  - aqueous foam
- Tire fires need to be detected and extinguished quickly



5 gal JP-8 / 1 gal gasoline



**FIXED**



# SUMMARY



Dist A.

- Fire remains a significant risk to military ground vehicles and their crews
  - ballistic damage
  - mechanical or electrical malfunction
- Fire protection improvements continue to be made on tactical, as well as combat, vehicles
- Passive fire protection techniques needed to operate effectively in emerging combat conditions
- Further advances are required in the following areas:
  - external fire protection
  - environmentally superior extinguishing agents
  - smaller and lighter components
  - more field-supportable products